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(54)【発明の名称】 多色発光素子とその基板

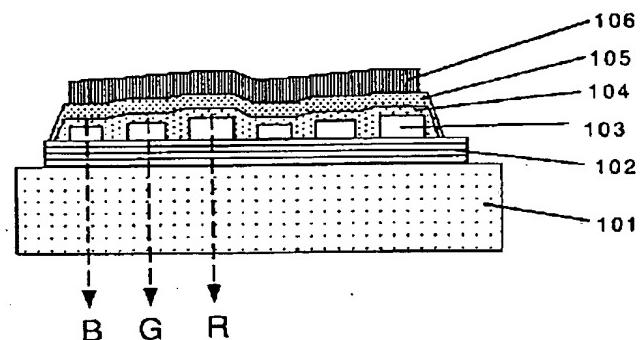
(57)【要約】

【目的】本発明の目的は、高効率の多色発光素子を実現し、情報通信分野において、表示素子、通信用発光デバイス、情報ファイル用読／書ヘッド、印刷装置などに利用することにある。

【構成】発光機能を有する薄膜層の上下両面に反射鏡を形成してなる微小光共振器を含み、該微小光共振器は前記反射鏡間の光学的距離が異なる画素を少なくとも2個以上有することを特徴とする多色発光素子。

【効果】本発明は、单一基体を用いて、簡単な構造で、高効率の多色発光素子とその基板を提供できる。

図 1



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## 【特許請求の範囲】

【請求項1】発光機能を有する薄膜層の上下両面に反射鏡を形成してなる微小光共振器を含み、該微小光共振器は前記反射鏡間の光学的距離が異なる画素を少なくとも2個以上を有することを特徴とする多色発光素子。

【請求項2】発光機能を有する有機薄膜からなる発光層と、該発光層の両面に形成された反射鏡とで微小光共振器が構成され、該微小光共振器は前記反射鏡間の光学的距離が異なる画素を少なくとも2個以上有することを特徴とする多色発光素子。

【請求項3】透明基体上に半透明反射層、透明導電層、有機薄膜からなる発光層、電極が順次に形成され、前記半透明反射層と電極との間の光学的距離が異なる画素を少なくとも2個以上有することを特徴とする多色発光素子。

【請求項4】透明基体上に半透明反射層、透明導電層、有機薄膜からなる発光層、電極が順次に形成された多色発光素子であって、半透明反射層と電極との間の光学的距離が異なる画素を少なくとも2個以上有する微小光共振器を含むことを特徴とする多色発光素子。

【請求項5】透明基体上に半透明反射層、透明導電層、有機薄膜からなる発光層、電極が順次に形成された多色発光素子であって、半透明反射層と電極との間の構成が微小光共振器として作用し、複数の異なる発光スペクトルの光を同一基体上の素子から取り出すことを特徴とする多色発光素子。

【請求項6】有機薄膜からなる発光層がアルミニウムキレート系化合物より形成されていることを特徴とする請求項2～5記載の多色発光素子。

【請求項7】透明基体上に半透明反射層を有し、該半透明反射層上に透明導電層が配置され、該透明導電層上有機薄膜からなる発光層が設けられており、その上に電極が形成された有機発光素子であって、前記半透明反射層は発光層での発光の一部を透明基体側に透過し、発光の一部を発光層側に反射する反射機能を有し、該半透明反射層は発光層背面の電極とで光共振器として作用し、かつ半透明反射層と電極との間の光学的距離が異なるように構成されていることを特徴とする多色発光素子。

【請求項8】透明基体上に半透明反射層を有し、該半透明反射層上に透明導電層が配置され、該透明導電層上有ホール注入層、有機薄膜からなる発光層、電子注入層が順に設けられており、その上に電極が形成された有機発光素子であって、前記半透明反射層は発光層での発光の一部を透明基体側に透過し、発光の一部を発光層側に反射する反射機能を有し、該半透明反射層は発光層背面の電極とで光共振器として作用し、かつ半透明反射層と電極との間の光学的距離が異なるように構成されていることを特徴とする多色発光素子。

【請求項9】透明基体上に半透明反射層を有し、該半透明反射層上に透明導電層が配置され、該透明導電層上に

ホール注入層、有機薄膜からなる発光層が設けられており、その上に電極が形成された有機発光素子であって、前記半透明反射層は発光層での発光の一部を透明基体側に透過し、発光の一部を発光層側に反射する反射機能を有し、該半透明反射層は発光層背面の電極とで光共振器として作用し、かつ半透明反射層と電極との間の光学的距離が異なるように構成されていることを特徴とする多色発光素子。

【請求項10】透明基体上に半透明反射層を有し、該半透明反射層上に透明導電層が配置され、該透明導電層上有機薄膜からなる発光層、電子注入層が順に設けられており、その上に電極が形成された有機発光素子であって、前記半透明反射層は発光層での発光の一部を透明基体側に透過し、発光の一部を発光層側に反射する反射機能を有し、該半透明反射層は発光層背面の電極とで光共振器として作用し、かつ半透明反射層と電極との間の光学的距離が異なるように構成されていることを特徴とする多色発光素子。

【請求項11】前記半透明反射層と発光層背面の電極とで生じる反射光の位相のシフトをAラジアンとするとき、半透明反射層と発光層背面の電極との間の光学的距離しが(整数-A/2π)倍〔但し、S<(2L)<Tであり、S、Tは、前記半透明反射層を持たない発光素子の発光スペクトルにおける発光強度が最大強度の1/2となる波長を示す。〕である請求項7～10に記載の多色発光素子。

【請求項12】前記半透明反射層と発光層背面の電極との間の光学的距離が、取出す光のピーク波長の0.9～1.1倍またはその整数倍である請求項7～10に記載の多色発光素子。

【請求項13】前記半透明反射層と発光層背面の電極とで生じる反射光の位相のシフトがAラジアンとするとき、半透明反射層と発光層背面の電極との間の光学的距離しが〔取出す光のピーク波長×(整数-A/2π)/2〕の長さの0.9～1.1倍である請求項7～10に記載の多色発光素子。

【請求項14】前記透明導電層、ホール注入層、発光層および電子注入層の各層の厚さとそれぞれの屈折率との積で表される光学的距離の和が、発光のピーク波長と同じもしくは近似している請求項8に記載の多色発光素子。

【請求項15】前記半透明反射層が誘電体の多層膜で構成されている請求項7～10に記載の多色発光素子。

【請求項16】前記半透明反射層が発光取出し窓を有する金属製全反射膜で構成されている請求項7～14に記載の多色発光素子。

【請求項17】前記半透明反射層の反射率が50～99.9%または透過率が50～0.1%である請求項7～15に記載の多色発光素子。

【請求項18】透明基板と、その上に光の一部を透過

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し、一部を反射する誘電体の多層膜からなる半透明反射層を備え、該半透明反射層上に透明導電層を有することを特徴とする多色発光素子用基板。

【請求項19】透明基板と、その上に誘電体の多層膜からなる半透明反射層を備え、該半透明反射層上に透明導電膜を有し、前記半透明反射層の反射率が50～99.9%または透過率が50～0.1%であることを特徴とする多色発光素子用基板。

【請求項20】透明基板と、その上に透明導電膜と透明絶縁膜とを積層した半透明反射層を備え、該半透明反射層上に透明導電膜を有することを特徴とする多色発光素子用基板。

【請求項21】前記透明基板が石英、ガラスまたはプラスチックからなる透明基板であり、前記半透明反射層上に透明導電膜がバーニングされている請求項18、19または20に記載の多色発光素子用基板。

#### 【発明の詳細な説明】

##### 【0001】

【産業上の利用分野】多色発光素子に関し、表示素子、通信用発光デバイス、情報ファイル用読／書ヘッド、印刷装置などの情報通信分野において利用される。

##### 【0002】

【從来の技術】從来の有機発光素子は、有機蛍光体薄膜の発光をそのまま取出した時は、それぞれの蛍光体の種類に応じた、1種類の発光スペクトルしか得られなかつた。該手段において発光の前面にカラーフィルタを形成して発光スペクトルの一部分を取り出すことは可能であるが、取り出した光のピークの発光強度はカラーフィルタなしの場合の発光スペクトルの強度より小さくなるため、効率の大幅な低下を招く欠点がある。例えば、酸化錫インジウム等の透明電極を有する透明基板間に、有機発光体と電気絶縁性の結合剤とからなる発光体を介在させ、前記電極の陽極電極と発光体域との間にポルフィリン系化合物層を形成した有機エレクトロルミネセンスセルが提案されている（特開昭57-51781号公報）。

【0003】また、無機系発光体（硫化亜鉛を主成分とする）層の熱処理の有無によるエッティングレートの差異を利用し、互いに発光色が異なる複数種の発光体層を同一基板上に形成することを特徴とする多色発光EL素子が提案されている（特公平5-15037号公報）。

##### 【0004】

【発明が解決しようとする課題】こうした有機薄膜を用いた発光素子は安価に提供できると云う特長を有しているが、スペクトル幅が広いために青色発光しか実現されておらず、特殊なディスプレイ等に限られていた。

【0005】本発明の目的は、スペクトル幅と発光特性を改善した有機発光素子を提供することにある。

【0006】また、本発明の他の目的は、上記有機発光素子用の基板を提供することにある。

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【課題を解決するための手段】上記課題を解決するために達成された本発明の手段は次のとおりである。

【0008】まず、第1の手段は、発光機能を有する薄膜層の上下両面に反射鏡を形成してなる微小光共振器を含み、該微小光共振器は前記反射鏡間の光学的距離が異なる画素を少なくとも2個以上有することを特徴とする多色発光素子。

【0009】第2の手段は、発光機能を有する有機薄膜からなる発光層と、該発光層の両面に形成された反射鏡とで微小光共振器が構成され、該微小光共振器は前記反射鏡間の光学的距離が異なる画素を少なくとも2個以上有することを特徴とする多色発光素子。

【0010】第3の手段は、透明基体上に半透明反射層、透明導電層、有機薄膜からなる発光層、電極が順次に形成され、前記半透明反射層と電極の間の光学的距離が異なる画素を少なくとも2個以上有することを特徴とする多色発光素子。

【0011】第4の手段は、透明基体上に半透明反射層、透明導電層、有機薄膜からなる発光層、電極が順次に形成された多色発光素子であって、半透明反射層と電極の間に光学的距離が異なる画素を少なくとも2個以上有する微小光共振器を含むことを特徴とする多色発光素子。

【0012】第5の手段は、透明基体上に半透明反射層、透明導電層、有機薄膜からなる発光層、電極が順次に形成された多色発光素子であって、半透明反射層と電極の間に構成が微小光共振器として作用し、複数の異なる発光スペクトルの光を同一基体上の素子から取り出すことを特徴とする多色発光素子。

【0013】第6の手段は、透明基体上に半透明反射層を有し、該半透明反射層上に透明導電層が配置され、該透明導電層上に有機薄膜からなる発光層が設けられており、その上に電極が形成された有機発光素子であって、前記半透明反射層は発光層での発光の一部を透明基体側に透過し、発光の一部を発光層側に反射する反射機能を有し、該半透明反射層は発光層背面の電極とで光共振器として作用し、かつ半透明反射層と電極との間の光学的距離が異なるように構成されていることを特徴とする多色発光素子。

【0014】第7の手段は、透明基体上に半透明反射層を有し、該半透明反射層上に透明導電層が配置され、該透明導電層上にホール注入層、有機薄膜からなる発光層、電子注入層が順に設けられており、その上に電極が形成された有機発光素子であって、前記半透明反射層は発光層での発光の一部を透明基体側に透過し、発光の一部を発光層側に反射する反射機能を有し、該半透明反射層は発光層背面の電極とで光共振器として作用し、かつ半透明反射層と電極との間の光学的距離が異なるように構成されていることを特徴とする多色発光素子。

【0015】第8の手段は、透明基体上に半透明反射層

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を有し、該半透明反射層上に透明導電層が配置され、該透明導電層上にホール注入層、有機薄膜からなる発光層が設けられており、その上に電極が形成された有機発光素子であって、前記半透明反射層は発光層での発光の一部を透明基体側に透過し、発光の一部を発光層側に反射する反射機能を有し、該半透明反射層は発光層背面の電極とで光共振器として作用し、かつ半透明反射層と電極との間の光学的距離が異なるように構成されていることを特徴とする多色発光素子。

【0016】第9の手段は、透明基体上に半透明反射層を有し、該半透明反射層上に透明導電層が配置され、該透明導電層上有機薄膜からなる発光層、電子注入層が順に設けられており、その上に電極が形成された有機発光素子であって、前記半透明反射層は発光層での発光の一部を透明基体側に透過し、発光の一部を発光層側に反射する反射機能を有し、該半透明反射層は発光層背面の電極とで光共振器として作用し、かつ半透明反射層と電極との間の光学的距離が異なるように構成されていることを特徴とする多色発光素子。

【0017】第10の手段は、透明基板と、その上に光の一部を透過し、一部を反射する誘電体の多層膜からなる半透明反射層を備え、該半透明反射層上に透明導電膜を有することを特徴とする多色発光素子用基板。

【0018】第11の手段は、透明基板と、その上に誘電体の多層膜からなる半透明反射層を備え、該半透明反射層上に透明導電膜を有し、前記半透明反射層の反射率が50～99.9%または透過率が50～0.1%であることを特徴とする多色発光素子用基板。

【0019】第12の手段は、透明基板と、その上に透明導電膜と透明絶縁膜とを積層した半透明反射層を備え、該半透明反射層上に透明電導膜を有することを特徴とする多色発光素子用基板を提供することにある。

【0020】本発明において、前記透明基板が石英、ガラスまたはプラスチックからなる透明基板であり、また、前記半透明反射層上に透明導電膜がパターニングされている多色発光素子用基板である。

【0021】本発明において、前記半透明反射層と発光層背面の電極とで生じる反射光の位相シフトをAラジアンするとき、半透明反射層と発光層背面の電極との間の光学的距離Lが(整数-A/2π)倍(但し、S<(2L)<Tであり、S、Tは、前記半透明反射層を持たない発光素子の発光スペクトルにおける発光強度が最大強度の1/2となる波長を示す。)である多色発光素子。

【0022】本発明において、前記半透明反射層と発光層背面の電極との間の光学的距離が、取出す光のピーク波長の0.9～1.1倍またはその整数倍である多色発光素子。

【0023】本発明において、前記半透明反射層と発光層背面の電極とで生じる反射光の位相シフトがAラジアンとするとき、半透明反射層と発光層背面の電極との間

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の光学的距離Lが〔取出す光のピーク波長×(整数-A/2π)/2〕の長さの0.9～1.1倍である多色発光素子。

【0024】本発明において、前記透明導電層、ホール注入層、発光層および電子注入層の各層の厚さとそれぞれの屈折率との積で表される光学的距離の和が、発光のピーク波長と同じもしくは近似している多色発光素子。

【0025】本発明において、前記半透明反射層が誘電体の多層膜で構成されている多色発光素子。

【0026】本発明において、前記半透明反射層が発光取出し窓を有する金属製全反射膜で構成されている多色発光素子。

【0027】本発明において、前記半透明反射層の反射率が50～99.9%または透過率が50～0.1%である多色発光素子である。

【0028】

【作用】透明基体上に半透明反射層、透明導電層、有機薄膜発光層、金属電極を備えた有機発光素子を用い、反透明反射層と電極の間が微小光共振器として作用する構

成とする。このとき、上下の反射鏡間の光学的距離を変えることにより、それぞれの距離に応じた異なる発光スペクトルの光(即ち多色光)を、同一基体上の素子から高効率で取出すことができる。

【0029】共振器の効果は半透明反射層がない時の発光の中央付近で大きく周辺で小さいが、反透明反射鏡の反射率を周辺部で大きくとることにより大きくできる。

【0030】

【実施例】

(実施例1) 図1において、ガラス基板101上に、TiO<sub>2</sub>膜とSiO<sub>2</sub>膜を積層した半透明反射層102を形成する。その上に、透明伝導膜(ITO)103、ジアミン誘電体(TAD)のホール注入層104、アルミニウムキレート(A1q3)の発光層105、Ag:Mg金属電極106を順に形成する。ITO電極103とAg:Mg金属電極106は互いに直交したマトリクスとなっていて、103をプラス、106をマイナスとして

10～15Vの直流電圧を印加すると、電極が交差している部分が画素として発光する。ここで、103、104、105のそれぞれの膜厚と屈折率の積から得られる光学的距離の和dは、半透明反射膜102がない時のA1q3の発光スペクトルの範囲である450nmと700nmの間の値である。

【0031】図2は、半透明反射膜がない時のA1q3の発光スペクトルを示す。透明伝導膜103の膜厚を変えることによりdの値を変え、光共振器の共振波長のピークを450nmと700nmの間で設定することが可能であり、図1の单一基体から、赤、緑、青の3色を取り出すことができる。

【0032】この場合、光共振器の利得に応じて、半透明反射膜がない時のA1q3の発光スペクトル成分より

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も強い発光を取り出すことが可能である。光共振器の共振波長のピークを変えるには、光学的距離の和dを変えれば良く、必ずしも透明伝導膜103の膜厚を変える必要はない。

【0033】(実施例2) 図3は、透明伝導膜(ITO)103、ジアミン誘導体(TAD)のホール注入層104、アルミニウムキレート(A1q3)の発光層105の膜厚はそれぞれ一定である。SiO<sub>2</sub>のスペーサー107を設置することにより、光学的距離の和dを変えて、赤(R)、緑(G)、青(B)発光が達成される。

【0034】また、共振の強度、スペクトルの半値幅は、半透明反射膜がない時の発光スペクトルに、どの様な透過/反射特性を有した半透明反射膜を組み合わせるかで決まる。従って、半透明反射膜の透過/反射特性により、各発光の共振の強度、スペクトルの半値幅を設定することが可能であり、RGBそれぞれの発光強度を、ディスプレイとして要求される強度比に近付けることができる。

【0035】本発明を用いたディスプレイは、作成の構造によっては、画素の平面と視線とのなす角度(視角)に応じて各色の発光のピーク位置がずれる場合が生じる。これは、画素を斜め方向から観測することにより、光学的距離の和dが実効的に変わることから生じる。これは、あらかじめ、基体の中心位置と周辺部とで、視角を考慮に入れて光学的距離の和dを設定することにより解決される。

【0036】(実施例3) 図1において、ガラス基板101上に、SiO<sub>2</sub>膜を積層した半透明反射膜102を形成する。その上に、透明伝導膜(ITO)103、ジアミン誘電体(TAD)のホール注入層104、ポルフィリンの発光層105、Ag:Mg金属電極106を順に形成する。ITOの電極103とAg:Mg金属電極106は互いに直交したマトリクスとなっていて、103をプラス、106をマイナスとして10~15Vの直流電圧を印加すると、電極が交差している部分が画素として発光する。ここで、103、104、105のそれぞれの膜厚と屈折率の積から得られる光学的距離の和dは、半透明反射膜102がない時のA1q3の発光スペクトルの範囲である450nmと700nmの間の値である。

【0037】図2は、半透明反射膜がない時のA1q3の発光スペクトルを示す。透明伝導膜103の膜厚を変えることによりdの値を変え、光共振器の共振波長のピークを450nmと700nmの間で設定することが可能であり、図1の单一基体から、赤、緑、青の3色を取り出すことができる。

【0038】この場合、光共振器の利得に応じて、半透明反射膜がない時のA1q3の発光スペクトル成分よりも強い発光を取り出すことが可能である。光共振器の共振波長のピークを変えるには、光学的距離の和dを変え

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れば良く、必ずしも透明伝導膜103の膜厚を変える必要はない。

【0039】(実施例4) 図1において、ガラス基板101には、TiO<sub>2</sub>膜とSiO<sub>2</sub>膜を積層した半透明反射膜102を形成する。その上に、透明伝導膜(ITO)103、ジアミン誘導体(TAD)のホール注入層104、アルミニウムキレート(A1q3)と硫化亜鉛とかなる発光層105、Ag:Mg金属電極106を順に形成する。ITO電極103とAg:Mg金属電極106は互いに直交したマトリクスとなっていて、103をプラス、106をマイナスとして10~15Vの直流電圧を印加すると、電極が交差している部分が画素として発光する。ここで、103、104、105のそれぞれの膜厚と屈折率の積から得られる光学的距離の和dは、半透明反射膜102がない時のA1q3の発光スペクトルの範囲である450nmと700nmの間の値である。

【0040】図2は、半透明反射膜がない時のA1q3の発光スペクトルを示す。透明伝導膜103の膜厚を変えることによりdの値を変え、光共振器の共振波長のピークを450nmと700nmの間で設定することが可能であり、図1の单一基体から、赤、緑、青の3色を取り出すことができる。

【0041】この場合、光共振器の利得に応じて、半透明反射膜がない時のA1q3の発光スペクトル成分よりも強い発光を取り出すことが可能である。光共振器の共振波長のピークを変えるには、光学的距離の和dを変えれば良く、必ずしも透明伝導膜103の膜厚を変える必要はない。

【0042】

【発明の効果】本発明によれば、単一基体を用いて簡単な構造で、高効率の多色発光素子とその基板を提供できる。

【図面の簡単な説明】

【図1】本発明の一実施例であり、透明伝導膜の膜厚を変えることによりRGB発光を実現するものである。

【図2】半透明反射膜がない時のA1q3の発光スペクトルと、光学的距離の和dを変えることにより取り出されるRGB各色発光である。

【図3】本発明の一実施例であり、SiO<sub>2</sub>のスペーサーを設置することにより、光学的距離の和dを変えて、RGB発光を実現するものである。

【図4】発光機能を有する有機発光素子部の両面に反射鏡を形成して作成した微小光共振器の発光素子の断面を示す。

【符号の説明】

101…硝子基板、102…TiO<sub>2</sub>とSiO<sub>2</sub>膜を積層した半透明反射膜、103…透明伝導膜(ITO)、104…ジアミン誘電体(TPB)のホール注入層、105…アルミニウムキレート(A1q3)の発光層、106

(6)

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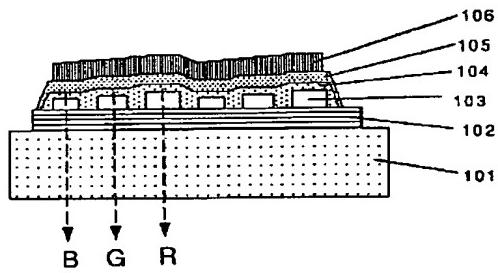
…Ag : Mg 金属電極、107…SiO<sub>2</sub> のスペーサー、  
—、108…誘電反射膜、109…有機発光素子部、1

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…反射膜。

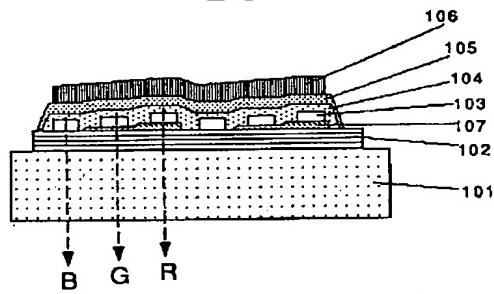
【図1】

図1



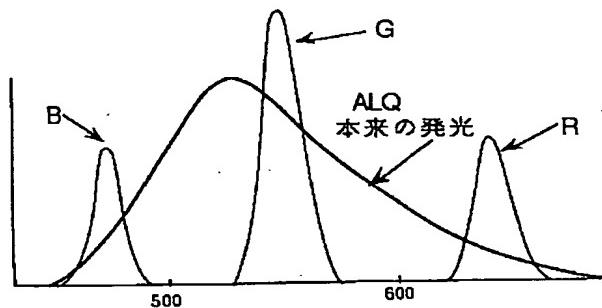
【図3】

図3



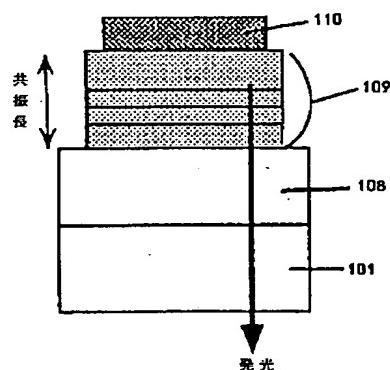
【図2】

図2



【図4】

図4



# PATENT ABSTRACTS OF JAPAN

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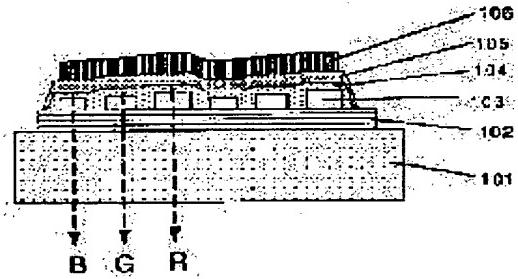
(72)Inventor : NAKAYAMA TAKAHIRO  
TSUNODA ATSUSHI  
IWAYAGI TAKAO

## (54) MULTICOLOR LUMINOUS ELEMENT AND SUBSTRATE THEREOF

### (57)Abstract:

PURPOSE: To improve spectrum width and a luminous characteristic by providing a fine light resonator in which reflecting mirrors are formed on both the surfaces of a thin film layer having a luminous function to install at least two picture elements, different in optical distance between the reflecting mirrors, in this resonator.

CONSTITUTION: A translucent reflecting layer 102 is formed on a glass base plate 101. Next thereon a transparent conductive film (ITO) 103, a hole injection layer 104, the luminous layer 105 of aluminum chelate (Alq3), and an Ag:Mg alloy electrode 106 are formed in order. The electrodes 103 and 106 are made mutually orthogonal matrix, and when A.C. voltage is applied with the electrode 103 as active and with the electrode 106 as negative, a part where the electrodes are crossed is made luminous as a picture element. Here, the sum of optical distances obtained from the product of each film thickness and refractive index of electrodes 103 and 105 is a value between 450 and 700nm, the range of the emission spectrum of the luminous layer 105 when the film 102 is absent.



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CLAIMS

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[Claim(s)]

[Claim 1] This minute optical resonator is a multicolor light emitting device characterized by having at least two or more pieces for the pixel from which the optical distance between the aforementioned reflecting mirrors differs including the minute optical resonator which comes to form a reflecting mirror in vertical both sides of a thin film layer which have a luminescence function.

[Claim 2] It is the multicolor light emitting device which a minute optical resonator consists of a luminous layer which consists of an organic thin film which has a luminescence function, and a reflecting mirror formed in both sides of this luminous layer, and is characterized by this minute optical resonator having at least two or more pixels from which the optical distance between the aforementioned reflecting mirrors differs.

[Claim 3] The multicolor light emitting device characterized by having at least two or more pixels from which the luminous layer and electrode which consist of a translucent reflecting layer, transparent conductive-layer, and organic thin film are formed one by one on a transparent base, and the optical distance between the aforementioned translucent reflecting layer and an electrode differs.

[Claim 4] The multicolor light emitting device which is a multicolor light emitting device by which the luminous layer which consists of a translucent reflecting layer, transparent conductive-layer, and organic thin film, and the electrode were formed one by one on the transparent base, and is characterized by including the minute optical resonator which has at least two or more pixels from which the optical distance between a translucent reflecting layer and an electrode differs.

[Claim 5] The multicolor light emitting device which is a multicolor light emitting device by which the luminous layer which consists of a translucent reflecting layer, transparent conductive-layer, and organic thin film, and the electrode were formed one by one on the transparent base, and is characterized by for the composition between a translucent reflecting layer and an electrode acting as a minute optical resonator, and taking out two or more light of a different emission spectrum from the element on the same base.

[Claim 6] The multicolor light emitting device according to claim 2 to 5 characterized by forming the luminous layer which consists of an organic thin film from the aluminum chelate system compound.

[Claim 7] Have a translucent reflecting layer on a transparent base, and a transparent conductive layer is arranged on this translucent reflecting layer. It is the organic light emitting device by which the luminous layer which consists of an organic thin film is prepared on this transparent conductive layer, and the electrode was formed on it. The aforementioned translucent reflecting layer penetrates a part of luminescence by the luminous layer to a transparent base side, and it has the reflex function which reflects a part of luminescence in a luminous layer side. This translucent reflecting layer is a multicolor light emitting device characterized by being constituted so that it may act as an optical resonator by the electrode on the tooth back of a luminous layer and the optical distances between a translucent reflecting layer and an electrode may differ.

[Claim 8] Have a translucent reflecting layer on a transparent base, and a transparent conductive layer is arranged on this translucent reflecting layer. The hole pouring layer, the luminous layer which consists of an organic thin film, and the electron-injection layer are prepared in order on this transparent conductive layer. Are the organic light emitting device in which the electrode was formed on it, and the aforementioned

translucent reflecting layer penetrates a part of luminescence by the luminous layer to a transparent base side. It is the multicolor light emitting device characterized by being constituted so that it may have the reflex function which reflects a part of luminescence in a luminous layer side, and this translucent reflecting layer may act as an optical resonator by the electrode on the tooth back of a luminous layer and the optical distances between a translucent reflecting layer and an electrode may differ.

[Claim 9] Have a translucent reflecting layer on a transparent base, and a transparent conductive layer is arranged on this translucent reflecting layer. The hole pouring layer and the luminous layer which consists of an organic thin film are prepared on this transparent conductive layer. Are the organic light emitting device in which the electrode was formed on it, and the aforementioned translucent reflecting layer penetrates a part of luminescence by the luminous layer to a transparent base side. It is the multicolor light emitting device characterized by being constituted so that it may have the reflex function which reflects a part of luminescence in a luminous layer side, and this translucent reflecting layer may act as an optical resonator by the electrode on the tooth back of a luminous layer and the optical distances between a translucent reflecting layer and an electrode may differ.

[Claim 10] Have a translucent reflecting layer on a transparent base, and a transparent conductive layer is arranged on this translucent reflecting layer. The luminous layer and electron-injection layer which consist of an organic thin film are prepared in order on this transparent conductive layer. Are the organic light emitting device in which the electrode was formed on it, and the aforementioned translucent reflecting layer penetrates a part of luminescence by the luminous layer to a transparent base side. It is the multicolor light emitting device characterized by being constituted so that it may have the reflex function which reflects a part of luminescence in a luminous layer side, and this translucent reflecting layer may act as an optical resonator by the electrode on the tooth back of a luminous layer and the optical distances between a translucent reflecting layer and an electrode may differ.

[Claim 11] When making into A radians the shift of the phase of the reflected light produced in the aforementioned translucent reflecting layer and the electrode on the tooth back of a luminous layer, the optical distances L between a translucent reflecting layer and the electrode on the tooth back of a luminous layer are twice ( $\text{integer}-A/2\pi$ ) [, however  $S < (2L) < T$ , and S and T show the wavelength from which the luminescence intensity in the emission spectrum without the aforementioned translucent reflecting layer of a light emitting device is set to one half of the maximum intensity. It comes out and is a certain multicolor light emitting device according to claim 7 to 10.

[Claim 12] The multicolor light emitting device according to claim 7 to 10 whose optical distance between the aforementioned translucent reflecting layer and the electrode on the tooth back of a luminous layer is 0.9 to 1.1 times or the integral multiple of those of the peak wavelength of the light to take out.

[Claim 13] The multicolor light emitting device according to claim 7 to 10 whose optical distance L between a translucent reflecting layer and the electrode on the tooth back of a luminous layer is 0.9 to 1.1 times the length of [peak-wavelength [ of the light to take out ] x ( $\text{integer}-A/2\pi$ )/2] when the shift of the phase of the reflected light produced in the aforementioned translucent reflecting layer and the electrode on the tooth back of a luminous layer considers as A radians.

[Claim 14] The multicolor light emitting device according to claim 8 which the sum of the optical distance expressed with the product of the thickness of each class of the aforementioned transparent conductive layer, a hole pouring layer, a luminous layer, and an electron-injection layer and each refractive index is the same as the peak wavelength of luminescence, or approximates.

[Claim 15] The multicolor light emitting device according to claim 7 to 10 by which the aforementioned translucent reflecting layer is constituted from a multilayer of a dielectric.

[Claim 16] The multicolor light emitting device according to claim 7 to 14 which consists of metal total reflection films by which the aforementioned translucent reflecting layer has a luminescence drawing aperture.

[Claim 17] The reflection factor of the aforementioned translucent reflecting layer is 50 – 99.9%. Or multicolor light emitting device according to claim 7 to 15 whose permeability is 50–0.1 %.

[Claim 18] The substrate for multicolor light emitting devices characterized by penetrating a part of light a

transparent substrate and on it, having the translucent reflecting layer which consists of a multilayer of the dielectric which reflects a part, and having a transparent conductive layer on this translucent reflecting layer.

[Claim 19] a transparent substrate and the translucent reflecting layer which consists of a multilayer of a dielectric on it -- having -- this translucent reflecting layer top -- a transparent electric conduction film -- having -- the reflection factor of the aforementioned translucent reflecting layer -- 50 - 99.9% or permeability -- 50 - 0.1% it is -- substrate for multicolor light emitting devices characterized by things

[Claim 20] A transparent substrate and the substrate for multicolor light emitting devices characterized by having on it the translucent reflecting layer which carried out the laminating of a transparent electric conduction film and the transparent insulator layer, and having a transparent electric conduction film on this translucent reflecting layer.

[Claim 21] The substrate for multicolor light emitting devices according to claim 18, 19, or 20 which is a transparent substrate which the aforementioned transparent substrate turns into from a quartz, glass, or plastics and by which patterning of the transparent electric conduction film is carried out on the aforementioned translucent reflecting layer.

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## DETAILED DESCRIPTION

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### [Detailed Description of the Invention]

#### [0001]

[Industrial Application] In information communication fields, such as a display device, a luminescence device for communication, \*\* / writing head for an information file, and a printer, it is used about a multicolor light emitting device.

#### [0002]

[Description of the Prior Art] When the conventional organic light emitting device took out luminescence of an organic-fluorescent-substance thin film as it was, only one kind of emission spectrum according to the kind of each fluorescent substance was acquired. Although it is possible to form a light filter in the front face of luminescence in this means, and to take out a part of emission spectrum, since the luminescence intensity of the peak of the taken-out light becomes smaller than the intensity of the emission spectrum in the case of having no light filter, it has the fault which causes the sharp decline in efficiency. For example, the emitter which consists of an organic emitter and a binder of electric insulation is made to intervene between the transparent substrates which have transparent electrodes, such as a tin-oxide indium, and the organic electroluminescence cell in which the porphyrin system compound layer was formed between the anode plate electrode of the aforementioned electrode and the emitter region is proposed (JP,57-51781,A).

[0003] Moreover, the difference in the etching rate by the existence of heat treatment of an inorganic system emitter (let zinc sulfide be principal component) layer is used, and the multicolor luminescence EL element characterized by forming two or more sorts of emitter layers from which the luminescent color differs mutually on the same substrate is proposed (JP,5-15037,B).

#### [0004]

[Problem(s) to be Solved by the Invention] Although it had the feature referred to as being able to offer cheaply the light emitting device using such an organic thin film, only blue luminescence was realized at the latus sake, but spectral band width was restricted to the special display etc.

[0005] The purpose of this invention is to offer the organic light emitting device which has improved spectral band width and the luminescence property.

[0006] Moreover, other purposes of this invention are to offer the substrate for the above-mentioned organic light emitting devices.

#### [0007]

[Means for Solving the Problem] The means of this invention attained in order to solve the above-mentioned technical problem is as follows.

[0008] First, this minute optical resonator is a multicolor light emitting device characterized by having at least two or more pixels from which the optical distance between the aforementioned reflecting mirrors differs including the minute optical resonator by which the 1st means comes to form a reflecting mirror in vertical both sides of a thin film layer which have a luminescence function.

[0009] It is the multicolor light emitting device which a minute optical resonator consists of a luminous layer which the 2nd means becomes from the organic thin film which has a luminescence function, and a reflecting mirror formed in both sides of this luminous layer, and is characterized by this minute optical resonator having at least two or more pixels from which the optical distance between the aforementioned reflecting mirrors differs.

[0010] The 3rd means is a multicolor light emitting device characterized by having at least two or more pixels from which the luminous layer and electrode which consist of a translucent reflecting layer, transparent conductive-layer, and organic thin film are formed one by one on a transparent base, and the optical distance between the aforementioned translucent reflecting layer and an electrode differs.

[0011] The 4th means is a multicolor light emitting device which is a multicolor light emitting device by which the luminous layer which consists of a translucent reflecting layer, transparent conductive-layer, and organic thin film, and the electrode were formed one by one on the transparent base, and is characterized by between a translucent reflecting layer and electrodes containing the minute optical resonator which has at least two or more pixels from which an optical distance differs.

[0012] The 5th means is a multicolor light emitting device characterized by taking out the light of the emission spectrum from which it is the multicolor light emitting device by which the luminous layer which consists of a translucent reflecting layer, transparent conductive-layer, and organic thin film, and the electrode were formed one by one on the transparent base, composition acts as a minute optical resonator between a translucent reflecting layer and an electrode, and plurality differs from the element on the same base.

[0013] The 6th means has a translucent reflecting layer on a transparent base, and a transparent conductive layer is arranged on this translucent reflecting layer. It is the organic light emitting device by which the luminous layer which consists of an organic thin film is prepared on this transparent conductive layer, and the electrode was formed on it. The aforementioned translucent reflecting layer penetrates a part of luminescence by the luminous layer to a transparent base side, and it has the reflex function which reflects a part of luminescence in a luminous layer side. This translucent reflecting layer is a multicolor light emitting device characterized by being constituted so that it may act as an optical resonator by the electrode on the tooth back of a luminous layer and the optical distances between a translucent reflecting layer and an electrode may differ.

[0014] The 7th means has a translucent reflecting layer on a transparent substrate, and a transparent conductive layer is arranged on this translucent reflecting layer. The hole pouring layer, the luminous layer which consists of an organic thin film, and the electron-injection layer are prepared in order on this transparent conductive layer. Are the organic light emitting device in which the electrode was formed on it, and the aforementioned translucent reflecting layer penetrates a part of luminescence by the luminous layer to a transparent base side. It is the multicolor light emitting device characterized by being constituted so that it may have the reflex function which reflects a part of luminescence in a luminous layer side, and this translucent reflecting layer may act as an optical resonator by the electrode on the tooth back of a luminous layer and the optical distances between a translucent reflecting layer and an electrode may differ.

[0015] The means of the octavus has a translucent reflecting layer on a transparent base, and a transparent conductive layer is arranged on this translucent reflecting layer. The hole pouring layer and the luminous layer which consists of an organic thin film are prepared on this transparent conductive layer. Are the organic light emitting device in which the electrode was formed on it, and the aforementioned translucent reflecting layer penetrates a part of luminescence by the luminous layer to a transparent base side. It is the multicolor light emitting device characterized by being constituted so that it may have the reflex function which reflects a part of luminescence in a luminous layer side, and this translucent reflecting layer may act as an optical resonator by the electrode on the tooth back of a luminous layer and the optical distances between a translucent reflecting layer and an electrode may differ.

[0016] The 9th means has a translucent reflecting layer on a transparent base, and a transparent conductive layer is arranged on this translucent reflecting layer. The luminous layer and electron-injection layer which consist of an organic thin film are prepared in order on this transparent conductive layer. Are the organic light emitting device in which the electrode was formed on it, and the aforementioned translucent reflecting layer penetrates a part of luminescence by the luminous layer to a transparent base side. It is the multicolor light emitting device characterized by being constituted so that it may have the reflex function which reflects a part of luminescence in a luminous layer side, and this translucent reflecting layer may act as an optical resonator by the electrode on the tooth back of a luminous layer and

the optical distances between a translucent reflecting layer and an electrode may differ.

[0017] The 10th means is a substrate for multicolor light emitting devices characterized by penetrating a part of light a transparent substrate and on it, having the translucent reflecting layer which consists of a multilayer of the dielectric which reflects a part, and having a transparent electric conduction film on this translucent reflecting layer.

[0018] The 11th means is equipped with the translucent reflecting layer which consists of a multilayer of a dielectric on it, and has a transparent electric conduction film on this translucent reflecting layer, and the reflection factor of the aforementioned translucent reflecting layer is [ a transparent substrate and ] 50 – 99.9%. Or substrate for multicolor light emitting devices characterized by permeability being 50 – 0.1%.

[0019] The 12th means is to offer a transparent substrate and the substrate for multicolor light emitting devices characterized by having on it the translucent reflecting layer which carried out the laminating of a transparent electric conduction film and the transparent insulator layer, and having a transparent conducting film on this translucent reflecting layer.

[0020] In this invention, it is the transparent substrate which the aforementioned transparent substrate turns into from a quartz, glass, or plastics, and is the substrate for multicolor light emitting devices by which patterning of the transparent electric conduction film is carried out on the aforementioned translucent reflecting layer.

[0021] The multicolor light emitting device whose optical distance L between a translucent reflecting layer and the electrode on the tooth back of a luminous layer is twice (integer-A/2pi) (however, it is S<(2L) < T and S and T show the wavelength from which the luminescence intensity in the emission spectrum without the aforementioned translucent reflecting layer of a light emitting device is set to one half of the maximum intensity.) when carrying out A radians of phase shifts of the reflected light produced in the aforementioned translucent reflecting layer and the electrode on the tooth back of a luminous layer

[0022] The multicolor light emitting device which is 0.9 to 1.1 times or the integral multiple of those of the peak wavelength of the light which the optical distance between the aforementioned translucent reflecting layer and the electrode on the tooth back of a luminous layer takes out in this invention.

[0023] When the phase shift of the reflected light produced in the aforementioned translucent reflecting layer and the electrode on the tooth back of a luminous layer considers as A radians in this invention, the optical distance L between a translucent reflecting layer and the electrode on the tooth back of a luminous layer is 0.9–1.1 of the length of [peak-wavelength [ of the light to take out ] x (integer-A/2pi)/2].

Multicolor light emitting device which is twice.

[0024] The multicolor light emitting device which the sum of the optical distance expressed with the product of the thickness of each class of the aforementioned transparent conductive layer; a hole pouring layer, a luminous layer, and an electron-injection layer and each refractive index is the same as the peak wavelength of luminescence, or approximates in this invention.

[0025] The multicolor light emitting device by which the aforementioned translucent reflecting layer is constituted from a multilayer of a dielectric in this invention.

[0026] The multicolor light emitting device which consists of metal total reflection films by which the aforementioned translucent reflecting layer has a luminescence drawing aperture in this invention.

[0027] this invention -- setting -- the reflection factor of the aforementioned translucent reflecting layer -- 50 – 99.9% or permeability -- 50 – 0.1% it is -- it is a multicolor light emitting device

[0028]

[Function] Between an anti-transparent reflecting layer and electrodes considers as the composition which acts as a minute optical resonator using the organic light emitting device equipped with the translucent reflecting layer, transparent conductive-layer, and organic thin film luminous layer and the metal electrode on the transparent base. At this time, by changing the optical distance between up-and-down reflecting mirrors, it is efficient and the light (namely, multicolor light) of a different emission spectrum according to each distance can be taken out from the element on the same base.

[0029] Although it is greatly [ near the center of luminescence in case the effect of a resonator does not have a translucent reflecting layer ] small in the circumference, it can do greatly by taking the large

reflection factor of an anti-transparent reflecting mirror by the periphery.

[0030]

[Example]

(Example 1) In drawing 1, the translucent reflecting layer 102 which carried out the laminating of TiO<sub>2</sub> film and the SiO<sub>2</sub> film is formed on a glass substrate 101. Moreover, a transparent electroconductive thin film (ITO) 103, the hole pouring layer 104 of a diamine dielectric (TAD), the luminous layer 105 of an aluminum chelate (Alq3), and the Ag:Mg metal electrode 106 are formed in order. The ITO electrode 103 and the Ag:Mg metal electrode 106 serve as a matrix which intersected perpendicularly mutually, and if considering 103 as plus and the direct current voltage of 10–15V is impressed by considering 106 as minus, the portion which the electrode intersects will emit light as a pixel. Here, the sum d of the optical distance obtained from each thickness of 103,104,105 and the product of a refractive index is a value between 450nm which is the range of the emission spectrum of Alq3 in case there is no translucent reflective film 102, and 700nm.

[0031] Drawing 2 shows the emission spectrum of Alq3 in case there is no translucent reflective film. By changing the thickness of a transparent electroconductive thin film 103, the value of d is changed, it is possible to set up the peak of the resonant wavelength of an optical resonator between 450nm and 700nm, and three colors of red, green, and blue can be taken out from the single base of drawing 1.

[0032] In this case, it is possible to take out strong luminescence from the emission spectrum component of Alq3 in case there is no translucent reflective film according to the gain of an optical resonator. In order to change the peak of the resonant wavelength of an optical resonator, it is not necessary to necessarily change the thickness of a transparent electroconductive thin film 103 that what is necessary is just to change the sum d of an optical distance.

[0033] (Example 2) The thickness of drawing 3 of a transparent electroconductive thin film (ITO) 103, the hole pouring layer 104 of a diamine derivative (TAD), and the luminous layer 105 of an aluminum chelate (Alq3) is fixed respectively. SiO<sub>2</sub> By installing a spacer 107, the sum d of an optical distance is changed and red (R), green (G), and blue (B) luminescence are attained.

[0034] Moreover, the intensity of resonance and the half-value width of a spectrum are decided by whether a translucent reflective film with what transparency/reflection property is combined with an emission spectrum in case there is no translucent reflective film. Therefore, it is possible to set up the intensity of resonance of each luminescence and the half-value width of a spectrum by transparency/reflection property of a translucent reflective film, and it can bring close to the intensity ratio of which the luminescence intensity of each RGB is required as a display.

[0035] Depending on the structure of creation, the case where the peak position of luminescence of each color shifts according to the angle (viewing angle) of the flat surface of a pixel and a visual axis to make produces the display using this invention. This is produced from the sum d of an optical distance changing in efficiency by observing a pixel from across. Beforehand, this is with the center position of a base, and a periphery, and is solved by setting up the sum d of an optical distance, taking a viewing angle into consideration.

[0036] (Example 3) It sets to drawing 1 and is SiO<sub>2</sub> on a glass substrate 101. The translucent reflective film 102 which carried out the laminating of the film is formed. Moreover, a transparent electroconductive thin film (ITO) 103, the hole pouring layer 104 of a diamine dielectric (TAD), the luminous layer 105 of a porphyrin, and the Ag:Mg metal electrode 106 are formed in order. The electrode 103 and the Ag:Mg metal electrode 106 of ITO serve as a matrix which intersected perpendicularly mutually, and if considering 103 as plus and the direct current voltage of 10–15V is impressed by considering 106 as minus, the portion which the electrode intersects will emit light as a pixel. Here, the sum d of the optical distance obtained from each thickness of 103,104,105 and the product of a refractive index is a value between 450nm which is the range of the emission spectrum of Alq3 in case there is no translucent reflective film 102, and 700nm.

[0037] Drawing 2 shows the emission spectrum of Alq3 in case there is no translucent reflective film. By changing the thickness of a transparent electroconductive thin film 103, the value of d is changed, it is

possible to set up the peak of the resonant wavelength of an optical resonator between 450nm and 700nm, and three colors of red, green, and blue can be taken out from the single base of drawing 1.

[0038] In this case, it is possible to take out strong luminescence from the emission spectrum component of Alq3 in case there is no translucent reflective film according to the gain of an optical resonator. In order to change the peak of the resonant wavelength of an optical resonator, it is not necessary to necessarily change the thickness of a transparent electroconductive thin film 103 that what is necessary is just to change the sum d of an optical distance.

[0039] (Example 4) In drawing 1, the translucent reflective film 102 which carried out the laminating of TiO<sub>2</sub> film and the SiO<sub>2</sub> film is formed in a glass substrate 101. The luminous layer 105 and the Ag:Mg metal electrode 106 which moreover consist of a transparent electroconductive thin film (ITO) 103, the hole pouring layer 104 of a diamine derivative (TAD), an aluminum chelate (Alq3), and zinc sulfide are formed in order. The ITO electrode 103 and the Ag:Mg metal electrode 106 serve as a matrix which intersected perpendicularly mutually, and if considering 103 as plus and the direct current voltage of 10–15V is impressed by considering 106 as minus, the portion which the electrode intersects will emit light as a pixel. Here, the sum d of the optical distance obtained from each thickness of 103,104,105 and the product of a refractive index is a value between 450nm which is the range of the emission spectrum of Alq3 in case there is no translucent reflective film 102, and 700nm.

[0040] Drawing 2 shows the emission spectrum of Alq3 in case there is no translucent reflective film. By changing the thickness of a transparent electroconductive thin film 103, the value of d is changed, it is possible to set up the peak of the resonant wavelength of an optical resonator between 450nm and 700nm, and three colors of red, green, and blue can be taken out from the single base of drawing 1.

[0041] In this case, it is possible to take out strong luminescence from the emission spectrum component of Alq3 in case there is no translucent reflective film according to the gain of an optical resonator. In order to change the peak of the resonant wavelength of an optical resonator, it is not necessary to necessarily change the thickness of a transparent electroconductive thin film 103 that what is necessary is just to change the sum d of an optical distance.

[0042]

[Effect of the Invention] According to this invention, an efficient multicolor light emitting device and its substrate can be offered with easy structure using a single base.

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[Translation done.]

\* NOTICES \*

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## DESCRIPTION OF DRAWINGS

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### [Brief Description of the Drawings]

[Drawing 1] It is one example of this invention and RGB luminescence is realized by changing the thickness of a transparent electroconductive thin film.

[Drawing 2] It is RGB each color luminescence taken out by changing the emission spectrum of Alq3 in case there is no translucent reflective film, and the sum d of an optical distance.

[Drawing 3] It is one example of this invention and is SiO2. By installing a spacer, the sum d of an optical distance is changed and RGB luminescence is realized.

[Drawing 4] The cross section of the light emitting device of the minute optical resonator which formed and created the reflecting mirror to both sides of the organic light-emitting-device section which has a luminescence function is shown.

### [Description of Notations]

101 [ -- A transparent electroconductive thin film (ITO) 104 / -- The hole pouring layer of a diamine dielectric (TPB),, 105 / -- The luminous layer of an aluminum chelate (Alq3),, 106 / -- A Ag:Mg metal electrode, 107 / -- SiO2 / A spacer, 108 / -- Reflective film. / -- A dielectric reflective film, 109 -- The organic light-emitting-device section, 110 ] -- A glass substrate, 102 -- The translucent reflective film, 103 which carried out the laminating of the SiO2 film to

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[Translation done.]

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CORRECTION or AMENDMENT

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[Proposed Amendment]

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[Title of the Invention] A multicolor light emitting device and its substrate

[Claim(s)]

[Claim 1] It is the multicolor light emitting device which a minute optical resonator consists of a luminous layer which consists of an organic thin film which has a luminescence function, and a reflecting mirror formed in both sides of this luminous layer, and is characterized by this minute optical resonator having at least two or more pixels from which the optical distance between the aforementioned reflecting mirrors differs.

[Claim 2] The multicolor light emitting device which is a multicolor light emitting device by which the luminous layer which consists of a translucent reflecting layer, transparent conductive-layer, and organic thin film, and the electrode were formed one by one on the transparent base, and is characterized by including the minute optical resonator which has at least two or more pixels from which the optical distance between a translucent reflecting layer and an electrode differs.

[Claim 3] The multicolor light emitting device which is a multicolor light emitting device by which the luminous layer which consists of a translucent reflecting layer, transparent conductive-layer, and organic thin film, and the electrode were formed one by one on the transparent base, and is characterized by for the composition between a translucent reflecting layer and an electrode acting as a minute optical resonator, and taking out two or more light of a different emission spectrum from the element on the same base.

[Claim 4] Have a translucent reflecting layer on a transparent-body board, and a transparent conductive layer is arranged on this translucent reflecting layer. It is the organic light emitting device by which the luminous layer which consists of an organic thin film is prepared on this transparent conductive layer, and the electrode was formed on it. The aforementioned translucent reflecting layer penetrates a part of luminescence by the luminous layer to a transparent base side, and it has the reflex function which reflects a part of luminescence in a luminous layer side. This translucent reflecting layer is a multicolor light emitting device characterized by being constituted so that it may act as an optical resonator by the electrode on the tooth back of a luminous layer and the optical distances between a translucent reflecting layer and an electrode may differ.

[Claim 5] Have a translucent reflecting layer on a transparent base, and a transparent conductive layer is arranged on this translucent reflecting layer. The hole pouring layer and the luminous layer which consists of an organic thin film are prepared on this transparent conductive layer. Are the organic light emitting device in which the electrode was formed on it, and the aforementioned translucent reflecting layer penetrates a part of luminescence by the luminous layer to a transparent base side. It is the multicolor light emitting device characterized by being constituted so that it may have the reflex function which reflects a part of luminescence in a luminous layer side, and this translucent reflecting layer may act as an optical resonator by the electrode on the tooth back of a luminous layer and the optical distances between a translucent reflecting layer and an electrode may differ.

[Claim 6] When making into A radians the shift of the phase of the reflected light produced in the aforementioned translucent reflecting layer and the electrode on the tooth back of a luminous layer, the optical distances L between a translucent reflecting layer and the electrode on the tooth back of a luminous layer are twice (integer-A/2pi) [, however S<(2L) < T, and S and T show the wavelength from which the luminescence intensity in the emission spectrum without the aforementioned translucent reflecting layer of a light emitting device is set to one half of the maximum intensity. It comes out and is a multicolor light emitting device given in some claims 4 and 5.

[Claim 7] A multicolor light emitting device given in the claims 4 and 5 whose optical distances between the aforementioned translucent reflecting layer and the electrode on the tooth back of a luminous layer are 0.9 to 1.1 times or the integral multiple of those of the peak wavelength of the light to take out.

[Claim 8] A multicolor light emitting device given in the claims 4 and 5 whose optical distances L between a translucent reflecting layer and the electrode on the tooth back of a luminous layer are 0.9 to 1.1 times the length of [peak-wavelength [ of the light to take out ] x (integer-A/2pi)/2] when making into A radians the shift of the phase of the reflected light produced in the aforementioned translucent reflecting layer and the electrode on the tooth back of a luminous layer.

[Claim 9] The multicolor light emitting device according to claim 8 which the sum of the optical distance expressed with the product of the thickness of each class of the aforementioned transparent conductive layer, a hole pouring layer, a luminous layer, and an electron-injection layer and each refractive index is the same as the peak wavelength of luminescence, or approximates.

[Claim 10] The substrate for multicolor light emitting devices characterized by penetrating a part of light a transparent substrate and on it, having the translucent reflecting layer which consists of a multilayer of the dielectric which reflects a part, and having a transparent conductive layer on this translucent reflecting layer.

[Claim 11] a transparent substrate and the translucent reflecting layer which consists of a multilayer of a dielectric on it -- having -- this translucent reflecting layer top -- a transparent electric conduction film -- having -- the reflection factor of the aforementioned translucent reflecting layer -- 50 - 99.9% or permeability -- 50 - 0.1% it is -- substrate for multicolor light emitting devices characterized by things

#### [Detailed Description of the Invention]

#### [0001]

[Industrial Application] this invention is used about a multicolor light emitting device in information communication fields, such as a display device, a luminescence device for communication, \*\* / writing head for an information file, and a printer.

[0002]

[Description of the Prior Art] When the conventional organic light emitting device took out luminescence of an organic-fluorescent-substance thin film as it was, only one kind of emission spectrum according to the kind of each fluorescent substance was acquired. Although it is possible to form a light filter in the front face of luminescence in this means, and to take out a part of emission spectrum, since the luminescence intensity of the peak of the taken-out light becomes smaller than the intensity of the emission spectrum in the case of having no light filter, it has the fault which causes the sharp decline in efficiency. For example, the emitter which consists of an organic emitter and a binder of electric insulation is made to intervene between the transparent substrates which have transparent electrodes, such as a tin-oxide indium, and the organic electroluminescence cell in which the porphyrin system compound layer was formed between the anode plate electrode of the aforementioned electrode and the emitter region is proposed (JP,57-51781,A).

[0003] Moreover, the difference in the etching rate by the existence of heat treatment of an inorganic system emitter (let zinc sulfide be principal component) layer is used, and the multicolor luminescence EL element characterized by forming two or more sorts of emitter layers from which the luminescent color differs mutually on the same substrate is proposed (JP,5-15037,B).

[0004]

[Problem(s) to be Solved by the Invention] Although it had the feature referred to as being able to propose cheaply the light emitting device using such an organic thin film, only blue luminescence was realized at the latus sake, but spectral band width was restricted to the special display etc.

[0005] The purpose of this invention is to offer the organic light emitting device which has improved spectral band width and the luminescence property.

[0006] Moreover, other purposes of this invention are to offer the substrate for the above-mentioned organic light emitting devices.

[0007]

[Means for Solving the Problem] this invention which solves the above-mentioned technical problem is as follows.

[0008] A minute optical resonator consists of a luminous layer set to the 1st from the organic thin film which has a luminescence function, and a reflecting mirror formed in both sides of this luminous layer, and this minute optical resonator is in the multicolor light emitting device characterized by having at least two or more pixels from which the optical distance between the aforementioned reflecting mirrors differs.

[0009] It is the multicolor light emitting device by which the luminous layer which consists of a translucent reflecting layer, transparent conductive-layer, and organic thin film, and the electrode were formed one by one on the transparent base the 2nd, and is in the multicolor light emitting device characterized by including the minute optical resonator which has at least two or more pixels from which the optical distance between a translucent reflecting layer and an electrode differs.

[0010] It is the multicolor light emitting device by which the luminous layer which consists of a translucent reflecting layer, transparent conductive-layer, and organic thin film, and the electrode were formed one by one on the transparent base the 3rd, and composition acts as a minute optical resonator between a translucent reflecting layer and an electrode, and it is in the multicolor light emitting device characterized by taking out the light of the emission spectrum from which plurality differs from the element on the same substrate.

[0011] Have a translucent reflecting layer on a transparent base, and a transparent conductive layer is arranged on this translucent reflecting layer the 4th. It is the organic light emitting device by which the luminous layer which consists of an organic thin film is prepared on this transparent conductive layer, and the electrode was formed on it. The aforementioned translucent reflecting layer penetrates a part of luminescence by the luminous layer to a transparent base side, and it has the reflex function which reflects a part of luminescence in a luminous layer side. It is in the multicolor light emitting device characterized by constituting this translucent reflecting layer so that it may act as an optical resonator by the electrode on the tooth back of a luminous layer and the optical distances between a translucent reflecting layer and an electrode may differ.

[0012] Have a translucent reflecting layer on a transparent base, and a transparent conductive layer is arranged on this translucent reflecting layer the 5th. The hole pouring layer and the luminous layer which consists of an organic thin film are prepared on this transparent conductive layer. Are the organic light emitting device in which the electrode was formed on it, and the aforementioned translucent reflecting layer penetrates a part of luminescence by the luminous layer to a transparent base side. It is in the multicolor light emitting device characterized by being constituted so that it may have the reflex function which reflects a part of luminescence in a luminous layer side, and this translucent reflecting layer may act as an optical resonator by the electrode on the tooth back of a luminous layer and the optical distances between a translucent reflecting layer and an electrode may differ.

[0013] The 6th is equipped with the translucent reflecting layer which serves as a transparent substrate from the multilayer of the dielectric which penetrates a part of light and reflects a part on it, and it is in the substrate for multicolor light emitting devices characterized by having a transparent conductive layer on this translucent reflecting layer.

[0014] the translucent reflecting layer set to the 7th from the multilayer of a dielectric on it with a transparent substrate -- having -- this translucent reflecting layer top -- a transparent electric conduction film -- having -- the reflection factor of the aforementioned translucent reflecting layer -- 50 – 99.9%, or permeability -- 50 – 0.1% it is -- it is in the substrate for multicolor light emitting devices characterized by things

[0015]

[Function] Between an anti-transparent reflecting layer and electrodes considers as the composition which acts as a minute optical resonator using the organic light emitting device equipped with the translucent reflecting layer, transparent conductive-layer, and organic thin film luminous layer and the metal electrode on the transparent base. At this time, by changing the optical distance of up-and-down reflecting mirror Ming, it is efficient and the light (namely, multicolor light) of a different emission spectrum according to each distance can be taken out from the element on the same substrate.

[0016] Although it is greatly [ near the center of luminescence in case the effect of a resonator does not have a translucent reflecting layer ] small in the circumference, it can do greatly by taking the large reflection factor of an anti-transparent reflecting mirror by the periphery.

[0017]

[Example]

(Example 1) In drawing 1, the translucent reflective film 102 which carried out the laminating of TiO<sub>2</sub> film and the SiO<sub>2</sub> film is formed on a glass substrate 101. Moreover, a transparent electroconductive thin film (ITO) 103, the hole pouring layer 104 of a diamine dielectric (TAD), the luminous layer 105 of an aluminum chelate (Alq<sub>3</sub>), and the Ag:Mg metal electrode 106 are formed in order. The ITO electrode 103 and the Ag:Mg metal electrode 106 serve as a matrix which intersected perpendicularly mutually, and if considering 103 as plus and the direct current voltage of 10–15V is impressed by considering 106 as minus, the portion which the electrode intersects will emit light as a pixel. Here, the sum d of the optical distance obtained from each thickness of 103,104,105 and the product of a refractive index is a value between 450nm which is the range of the emission spectrum of Alq<sub>3</sub> in case there is no translucent reflective film 102, and 700nm.

[0018] Drawing 2 shows the emission spectrum of Alq<sub>3</sub> in case there is no translucent reflective film. By changing the thickness of a transparent electroconductive thin film 103, the value of d is changed, it is possible to set up the peak of the resonant wavelength of an optical resonator between 450nm and 700nm, and three colors of red, green, and blue can be taken out from the single base of drawing 1.

[0019] In this case, it is possible to take out strong luminescence from the emission spectrum component of Alq<sub>3</sub> in case there is no translucent reflective film according to the gain of an optical resonator. In order to change the peak of the resonant wavelength of an optical resonator, it is not necessary to necessarily change the thickness of a transparent electroconductive thin film 103 that what is necessary is just to change the sum d of an optical distance.

[0020] (Example 2) The thickness of drawing 3 of a transparent electroconductive thin film (ITO) 103, the

hole pouring layer 104 of a diamine derivative (TAD), and the luminous layer 105 of an aluminum chelate (Alq3) is fixed respectively. SiO<sub>2</sub> By installing a spacer 107, the sum d of an optical distance is changed and red (R), green (G), and blue (B) luminescence are attained.

[0021] Moreover, the intensity of resonance and the half-value width of a spectrum are decided by whether a translucent reflective film with what transparency/reflection property is combined with an emission spectrum in case there is no translucent reflective film. Therefore, it is possible to set up the intensity of resonance of each luminescence and the half-value width of a spectrum by transparency/reflection property of a translucent reflective film, and it can bring close to the intensity ratio of which the luminescence intensity of each RGB is required as a display.

[0022] Depending on the structure of creation, the case where the peak position of luminescence of each color shifts according to the angle (viewing angle) of the flat surface of a pixel and a visual axis to make produces the display using this invention. This is produced from the sum d of an optical distance changing in efficiency by observing a pixel from across. Beforehand, this is with the center position of a base, and a periphery, and is solved by setting up the sum d of an optical distance, taking a viewing angle into consideration.

[0023] (Example 3) It sets to drawing 1 and is SiO<sub>2</sub> on a glass substrate 101. The translucent reflective film 102 which carried out the laminating of the film is formed. Moreover, a transparent electroconductive thin film (ITO) 103, the hole pouring layer 104 of a diamine dielectric (TAD), the luminous layer 105 of a porphyrin, and the Ag:Mg metal electrode 106 are formed in order. The electrode 103 and the Ag:Mg metal electrode 106 of ITO serve as a matrix which intersected perpendicularly mutually, and if considering 103 as plus and the direct current voltage of 10–15V is impressed by considering 106 as minus, the portion which the electrode intersects will emit light as a pixel. Here, the sum d of the optical distance obtained from each thickness of 103,104,105 and the product of \*\*\*\*\* is a value between 450nm which is the range of the emission spectrum of Alq3 in case there is no translucent reflective film 102, and 700nm.

[0024] Drawing 2 shows the emission spectrum of Alq3 in case there is no translucent reflective film. By changing the thickness of a transparent electroconductive thin film 103, the value of d is changed, it is possible to set up the peak of the resonant wavelength of an optical resonator between 450nm and 700nm, and three colors of red, green, and blue can be taken out from the single base of drawing 1.

[0025] In this case, it is possible to take out strong luminescence from the emission spectrum component of Alq3 in case there is no translucent reflective film according to the gain of an optical resonator. In order to change the peak of the resonant wavelength of an optical resonator, it is not necessary to necessarily change the thickness of a transparent electroconductive thin film 103 that what is necessary is just to be able to obtain the sum d of an optical distance.

[0026] (Example 4) In drawing 1, the translucent reflective film 102 which carried out the laminating of TiO<sub>2</sub> film and the SiO<sub>2</sub> film is formed in a glass substrate 101. The luminous layer 105 and the Ag:Mg metal electrode 106 which moreover consist of a transparent electroconductive thin film (ITO) 103, the hole pouring layer 104 of a diamine derivative (TAD), an aluminum chelate (Alq3), and zinc sulfide are formed in order. The ITO electrode 103 and the Ag:Mg metal electrode 106 serve as a matrix which intersected perpendicularly mutually, and if considering 103 as plus and the direct current voltage of 10–15V is impressed by considering 106 as minus, the portion which the electrode intersects will emit light as a pixel. Here, the sum d of the optical distance obtained from each thickness of 103,104,105 and the product of a refractive index is a value between 450nm which is the range of the emission spectrum of Alq3 in case there is no translucent reflective film 102, and 700nm.

[0027] Drawing 2 shows the emission spectrum of Alq3 in case there is no translucent reflective film. By changing the thickness of a transparent electroconductive thin film 103, the value of d is changed, it is possible for the light of an optical resonator to set up the peak of wavelength between 450nm and 700nm, and red and three green and green colors can be taken out from the single base of drawing 1.

[0028] In this case, it is possible to take out strong luminescence from the emission spectrum component of Alq3 in case there is no translucent reflective film according to the gain of an optical resonator. In order to change the peak of the resonant wavelength of an optical resonator, it is not necessary to necessarily

change the thickness of a transparent electroconductive thin film 103 that what is necessary is just to change the sum d of an optical distance.

[0029]

[Effect of the Invention] According to this invention, an efficient multicolor light emitting device and its substrate can be offered with easy structure using a single base.

[Brief Description of the Drawings]

[Drawing 1] It is one example of this invention and RGB luminescence is realized by changing the thickness of a transparent electroconductive thin film.

[Drawing 2] It is RGB each color luminescence taken out by changing the emission spectrum of Alq3 in case there is no translucent reflective film, and the sum d of an optical distance.

[Drawing 3] It is one example of this invention and is SiO2. By installing a spacer, the sum d of an optical distance is changed and RGB luminescence is realized.

[Drawing 4] The cross section of the light emitting device of the minute optical resonator which formed and created the reflecting mirror to both sides of the organic light-emitting-device section which has a luminescence function is shown.

[Description of Notations]

101 [ -- A transparent electroconductive thin film (ITO) 104 / -- The hole pouring layer of a diamine dielectric (TPB), 105 / -- The luminous layer of an aluminum chelate (Alq3), 106 / -- A Ag:Mg metal electrode, 107 / -- SiO2 / A spacer, 108 / -- Reflective film. / -- A dielectric reflective film, 109 -- The organic light-emitting-device section, 110 ] -- A glass substrate, 102 -- The translucent reflective film, 103 which carried out the laminating of the SiO2 film to

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[Translation done.]